

## **RADIATOR PACKAGING SYSTEM**

### **CROSS-REFERENCE TO RELATED APPLICATIONS**

This application claims the benefit of U.S. Provisional Application No. 60/457,597 filed March 27, 2003.

### **FIELD OF THE INVENTION**

The invention relates to a system for packaging radiators and further to a method for packaging radiators for transport.

### **BACKGROUND**

After-market radiators are individually packaged products that ship to various destinations in variable quantities. The package is generally used for one trip, with the exception of immediate returns caused by part defects or shipping errors. The size, type of material, and ancillaries of the radiator family of products varies considerably, although the invariably lies within known parameters.

Existing packaging designs provided only limited and inconsistent protection against impact and accidental drop, resulting in structural, shape or functional damage to the product. Typical damage that can arise includes but is not limited to: deformation of core fins; bending of core supports; breakage of tank filler nozzle; and misalignment of fittings, etc.

Previous packaging protection consisted of several, operator-inserted, removable protective pieces of material, placed inside a generic paper corrugated box and somewhat around the radiator. Most of the damage was caused by misplaced protective material due to human error or inconsistencies of the method, that failed to protect the content under impact.

Other damage patterns emerged from loose protective material migrating toward the radiator core area and bending the thin edges of the heat exchanger fins.

The challenge became to develop a cost effective package design which was easy to use, less operator sensitive to assemble, and which would pass the industry standard tests for transport, handling, impact hazards and product integrity.

#### SUMMARY OF THE INVENTION

The packaging of the radiator is facilitated by affixing the radiator to a portion of the packaging, either a base unit which is positionable within a pair of telescoping box members or by affixing the radiator to one of the box members itself. Preferably, automatic banding devices are employed in the affixing of the radiator so as to provide uniform tightening.

In general, there is provided in one aspect of the invention packaging system for an article such as a radiator comprising packaging configured to receive the article therein, a pair of oppositely-extending flaps formed in a portion of the packaging, the flaps being bendable about opposed edges of the article; and constriction means for compressing the flaps against the edges of the article with sufficient force so as to retain the article therebetween by friction.

in another aspect of the invention, there is provided a method of packaging an article, such as a radiator, comprising: providing packaging configured to receive the article therein, there being formed in a portion of the packaging a pair of oppositely-extending, bendable flaps; positioning the article adjacent the portion of packaging and bending the flaps over opposed edges of the article; and applying at least one retention member over and around the bent flaps and article to compress the flaps against the edges of the article with sufficient force so as to retain the article therebetween by friction.

In general, one embodiment of the invention provides a base unit having a pair of opposed flaps, cut out from opposite edges of the base unit, which are adapted to wrap around opposed lateral edges of the radiator. The flaps and the portion of the base unit between the flaps may include a stiffening member, preferably made from corrugated plastic or the like to provide additional support for the packaging and

radiator to be affixed thereto. Friction material may be provided along the interior portion of the flaps which engages the edges of the radiator when the flaps are curved therearound. Preferably, the radiator is affixed to the base unit by banding which extends over the flaps and the back of the base unit to secure the radiator to the base unit. Cushioning inserts/pads are provided on both (planar) sides of the radiator for protection. The cushioning is affixed to the base unit in a prior operation. The base unit is designed to fit generally snugly within a lower cover member which is coverable by a corresponding upper cover member which telescopes internally within or externally over the lower cover member. The covers are then secured to one another to complete the package. Alternately, the base unit can be inserted into a box-like enclosure.

In another embodiment, the base unit is effectively integrated into one of the cover members. In general, the lower cover member is designed in its blank form to include the pair of opposed flaps. When the blank is assembled into the box-shape, the flaps appear as cut outs which extend from the base unit. The flaps are adapted to be wrapped around opposed lateral edges of the radiator. The flaps and the portion of the lower cover member between the flaps may include a stiffening member, preferably made from corrugated plastic or the like to provide additional support for the packaging. Friction material is provided along the interior portion of the flaps which engages the edges of the radiator when the flaps are curved therearound. Preferably, the radiator is affixed to the lower cover member by banding which extends over the flaps and the back of the lower cover member to secure the radiator thereto. Cushioning inserts/pads are provided on both sides of the radiator for protection. Preferably, the cushioning is affixed to the base unit in a prior operation. Where the flaps are "cut out" from the lower cover member, apertures result that may be covered by dust covers to prevent ingress of dust or other foreign material into the packaging when covered. The lower cover member is coverable by a corresponding upper cover member which telescopes over or is hinged to the lower cover member. The covers are then secured to one another to complete the package.

Preferably, the covers are oversized with respect to the range of sizes of radiators expected to be packaged therein. The flaps are adapted to be bent, folded or curved over a substantial portion of their length so that radiators of varying widths may be accommodated therebetween. The space surrounding the radiator on all sides provides some room for deformation/crushing of the package before potentially damaging contact with the radiator is made, effectively forming a "crush zone". The invention offers good protection against impact, ease and consistency of assembly, a high degree of universality (accommodates an entire group of radiators), at a competitive price. By providing a controlled banding grip (as a function of a predetermined tightness setting of an automatic banding machine) over the main structural elements of the radiator in conjunction with the dedicated packaging features (i.e. the friction flaps), frictional support perpendicular to the banding plane (direction) is provided wherein accidental, inertial shock energy is transferred to the whole protective packaging shell.

The impact energy transfer is distributed over a sufficiently wide grip-surface in such a manner that no radiator features are damaged and overall packaging deformation falls within allowable geometrical and functional limits.

These and other features and advantages of the invention will become apparent from the accompanying description and drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an exploded perspective view showing the upper cover member, base unit and lower cover member, respectively, of the first embodiment of the invention;

Fig. 2 is a plan view of the base unit blank;

Fig. 3 is a top plan view of the base unit;

Fig. 4 is a side elevation of the base unit of Fig. 3;

Fig. 5 is an exploded perspective view showing the embodiment of Fig. 1 with the radiator banded to the base unit;

Fig. 6 is an exploded perspective view showing the embodiment of Fig. 1 with the base unit with radiator banded thereto disposed within the lower cover member;

Fig. 7 an exploded perspective view showing the upper cover member and integral base unit/lower cover member, respectively, of the alternate embodiment of the invention;

Fig. 8 is a perspective view showing the embodiment of Fig. 10 with the radiator banded to the lower cover member; and

Fig. 9 is an exploded perspective view showing an arrangement similar to Fig. 5 which utilizes a base unit to which the radiator is bound, but with an alternate enclosure.

#### DETAILED DESCRIPTION OF THE INVENTION

Referring to Fig. 1, there is shown the primary components of the first embodiment of the radiator packaging 10 according to the invention. Fig. 1 shows the upper cover member 12 and a lower cover or tray member 14 as well as the base unit 16 to which the radiator is to be attached. Upper and lower cover members 12,14 may be made from any conventional packaging material such as multi-ply corrugated paperboard or the like.

The base unit 16 is preferably constructed out of a paper corrugated blank 18 as shown more specifically in Fig. 2, die-cut and scored to predetermined specifications. The base material may be single-, double-, or triple-wall, and of suitable board strength (i.e. ECT 45 - Edge Crush Test) for the intended purpose. Corrugated plastic may also be used. The size of the base unit 16 is predetermined in accordance with a range of sizes of radiators expected to be used with the packaging and is, in general, sized greater than the greatest expected size in the said range to ensure each radiator will fit within the area of the base unit 16 and to provide a crush zone for allowing some deformation/crushing of the package before potentially damaging contact with the radiator is made.

The shape of the base unit 16 is also the same as the lower cover member 14 but being sized slightly smaller so that the base unit 16 can fit within the lower cover member 14. In general, the aspect ratio of the cover members 12,14 will be similar to that of the radiator with the length roughly twice the size of its width and the return (height) much shorter than the other two dimensions, often as tall as 5-7 inches.

As shown in Fig. 2, the unique die-cutting pattern 18 of the base unit 16 features a pair of mid-body flap-cuts 20, resulting in a pair of flaps 22 of roughly 8 inches wide, but not necessarily so, with radiused corners 24 and end-sections 26, to avoid tearing and shear effect concentration in the narrowest section of the flaps. Although as shown the flaps 22 are disposed along the width dimension of the base unit 16, they could alternatively be provided along the length dimension.

The flaps 22 can fold upwardly and inwardly, as shown in Fig. 1, over the radiator part, creating a "C" shape structure as will be described below. If desired, four oval hand-hole size cuts 28 are optionally provided on opposite sides of the return (height) side panels 30 of the upper cover member 12. These cuts 28 only partially define the perimeter of the hand-hole access, leaving one length 32 of the oval shape uncut, so it can fold inside the pack, through the matching (full oval) holes 34 in the return side panels 36 of the lower cover member 14. If the upper cover member 12 is designed to telescopingly fit within the lower cover member 14, then partially cut holes would be provided on the "outer" lower cover member 14 while the full holes would be provided on the upper cover member 12.

The corner flaps 38 that help form the tray shape of upper and lower cover members 12,14 are glued or stapled in place in accordance with known techniques in the industry. Often, the glue used is a typical hot melt adhesive.

Seen in Fig. 1 and in detail in Figs. 3 and 4, a rectangular, flexible, reinforcing web member 40, preferably of polypropylene, is surface-laminated from one end to the other of the die-cut paper corrugated blank 18 and over each of the flaps 22. A given thickness of 4 mm was found to be optimal but not limiting. Corrugation of the

reinforcing polypropylene member 40 is designed to match the direction of banding, which is preferably generally perpendicular to the corrugations of the lower cover member 14. The reinforcing web member 40 should be sufficiently flexible to permit its bending/folding. The main purpose of the reinforcing web member 40 is to provide shear strength and core stiffness to the base unit 16.

Flexible, non-skid contact pads 42, preferably of polyethylene, are laminated over the reinforcing web member 40 at or about the areas which would be folded around the radiator edges, including at least a portion of the flaps 22. The non-skid contact pads 42 provide frictional grip under banding pressure. The thickness of the non-skid pads was determined to be optimal at 3/32", but not limited to that value. The non-skid pads 42 must also be bendable or foldable so that the laminate as a whole (the corrugated paperboard blank 18 of the base unit 16, the polypropylene material of the reinforcing web member 40, and the polyethylene material of the contact pads 42) can be folded or curved over the edges of the radiator.

Cushioning spacer blocks 44, preferably of urethane foam, are attached or adhered to the flat surface of the base unit 16, under the common pattern areas of the family of radiators that fit the particular size of the base unit 16 design. Preferably, these blocks 44 are situated symmetrically to better distribute loads placed thereon. These blocks 44 are generally about 1" thick, have a rectangular profile and have a density on the order of about 2-3 lbs/ft<sup>3</sup>, without being limited to these specifications. The thickness should provide sufficient depth for cushioning deformation to occur. The low density accommodates ridges and other features of the radiator without damage thereto. The surface area of the blocks 44 should be sufficient to account for distributed support and surface grip.

On the reverse side of the flaps 22, spacers 46,47, preferably of polystyrene, are provided at convenient locations, taking into consideration the banding requirements as explained below. The spacers 46,47, are secured or adhered to the reverse side of the flaps 22 so as not to inhibit bending of flaps 22 particularly in the expected area of bending. In this regard, the spacers 46,47 are preferably secured with adhesive 45

only along their outermost edges 46',47' nearest the ends of flaps 22 where bending is not expected to occur.

The thickness of the spacers 46,47 and the aforementioned blocks 44 are chosen to "fill" the spaces which would otherwise be left at the broad sides of the radiator for a given space between the base unit 16 and the upper cover member 12. In other words, the thicknesses of the blocks 44 and spacers 46,47 are chosen such that the upper surfaces of the spacers 46,47 abut the interior surface of the upper cover member 12 when the upper and lower cover members 12,14 are brought together. If the upper cover 12 is internally telescoped within the lower cover 14, it is possible that the base unit 16 may be trapped against the lower cover member 14 by the edge of the upper cover 12 which will assist in keeping the base unit 16 properly positioned.

One or more bands or retention members 50 are provided in order to secure the radiator 48 to the base unit 16. In the embodiment shown in Figs. 1, 4 and 5, a single band 50 is provided. However, double-banding may be preferred as it better distributes the banding forces and better resists rotational movement of the radiator 48. The band 50 may be pre-affixed to the base unit 16 or may be provided separately. By way of examples, the embodiment shown in Figs. 1, 4 and 5 includes a single spacer 47 on one flap 22 under which the band 50 could be secured or threaded through channel 49 and a pair of spacers 47 on the other flap 22 between which band 50 is positionable. Alternately, a pair of bands could be provided for positioning on both sides of the spacer 46 or beside the pair of spacers 47. The bands may be made of plastic, steel or other conventional materials.

During packing, the radiator 48 is placed generally centrally of the base unit 16 atop the cushioning blocks 44 as shown in Fig. 5. The flaps 22 are folded or bent around the opposed lateral edges of the radiator 48 such that the edges are in contact with the friction pads 42 which are on the "inside" of flaps 22. If not already affixed, the band 50 is arranged over the folded flaps 22 and tightened, preferably by way of an automatic banding machine (not shown) which is capable of securing one end of the band to the other end at a predetermined and pre-settable tension. The tension must

be sufficient to ensure the radiator 48 cannot slide relative to the folded flaps 22. In this regard, the friction material of the contact pads 42 assists in allowing considerably less tension to have to be applied as compared with a paperboard flap without such pads 42. An automatic banding machine eliminates operator-introduced variability.

The base unit 16, now having the radiator 48 banded thereto, is positioned within the lower tray member 14 as shown in Fig. 6 and the upper cover member 12 is applied. If provided, the folding hand-hole flaps 28 are pushed into the hand holes 34. While this arrangement may secure the upper and lower cover members 12,14 together, the cover members 12,14 may also be alternately or additionally secured together in other manners known in the industry, such as by stapling, banding, etc.

In Fig. 7, an alternate embodiment of the invention is illustrated in which the "base unit" of the above-mentioned radiator packaging 10 is effectively integrated with the lower cover or tray member 64. In the alternate radiator packaging 60, the flaps 72 are cut when the blank for the lower tray member 64 is being prepared. The reinforcing web member 90 is laminated to the flaps 72 and therebetween while the friction contact pads 92 are laminated to the reinforcing web member 90 at the expected bending locations. Although shown as disposed across the width of the lower tray 64, the reinforcing web member 90 and flaps 72 can be provided lengthwise, similar to that shown in Fig. 1.

A sufficient number/configuration of supportive cushioning blocks 94 are affixed to the lower tray member 64 at locations appropriate for the expected range of radiators to be accommodated by the packaging 60. Spacers 96 are provided on the reverse side of the flaps 72. One or more bands 100 (see Fig. 8) are provided to secure the radiator 98 to the lower tray member 64.

By providing the flaps 72 in the lower cover or tray member 64, apertures 102 result when the upper cover member 62 is applied. If left uncovered, these apertures 102 may result in ingress of undesirable material. Respective dust covers 104 may be

supplied to be positioned, as shown in phantom in Fig. 7, under the flap 72 but atop the inner surface of the lower tray member 64 along its sides, as shown in Fig. 8. The dust covers 104 may include tabs and shoulders (not shown), to assist with positioning and retention. The shoulders position the dust cover 104 with respect to the edge of the flap 72 while the tabs may be inserted into corresponding slots provided in the lower tray member 64. Although the dust cover 104 is preferably made from corrugated cardboard, paperboard or plastic, any suitable material may be used.

Alternately, in the case where the upper cover is inserted within the lower cover, the upper cover member 62 may be provided with dust covers (not shown) which can be inserted under the flaps 72 as the cover member 62 is being applied or, in the case where the upper cover 62 is telescoped over the lower cover 64, external dust covers may be provided on the upper cover 62 which are wrapped around the lower cover member 64 and over the apertures and affixed thereto.

As with the first embodiment, the radiator 98 is positioned atop the foam cushioning blocks 94 and generally centrally of the lower cover or tray member 64 as shown in Fig. 8. The flaps 72 are then bent or folded around the adjacent lateral edges of the radiator 98 and the dust covers 104, if provided, are positioned as aforesaid. The band(s) 100 is/are applied and then tensioned as with the first embodiment. The upper cover member 62 is applied and secured via the hand holds 28,34 and/or otherwise as with the first embodiment. Spacers 96, in conjunction with support blocks 94, space the radiator 98 centrally between the broad sides of the radiator packaging 60.

It will be appreciated that the configuration of the packaging can be highly varied. In general terms it will be sized in length and width so as to accommodate radiator's length and width dimensions with additional room to allow for a crush zone in the event of an impact. The components that form the enclosure of the packaging can also have different configurations. For example, while it has been shown that the upper and lower covers 12,14 and 62,64 are separate, they could be provided integrally as is known in the art such as by way of a folding hinge at respective adjacent edges. In

the alternate arrangement of the packaging 110 shown in Fig. 9, a base unit 116 (which is very similar to the base unit 16 shown in Fig. 5) is provided to which the radiator 148 is secured in the same manner as described above with respect to Figs. 1 to 5. The base unit 116 is designed to fit generally snugly within a box-like enclosure 114. By providing the base unit 116 at both ends with folded flanges 117, whose height  $H$  generally corresponds with the internal height (thickness)  $h$  of enclosure 114, the base unit 116 (and hence the radiator 148 attached thereto) will be less prone to movement in that dimension and thus tolerances for the thicknesses of the cushioning blocks and spacers can be reduced.

While the foregoing has described and illustrated novel packaging for use with radiators, it will be appreciated that the principles and structures can be applied to the packaging of various other products. It will therefore be appreciated that various other modifications and adaptations can be made without departing from the spirit of the invention as described herein.